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Proceedings of the Regional Peer Review on the Assessment of the Gulf of St. Lawrence (4RST) Greenland Halibut Stock

**February 22, 2017
Mont-Joli, QC**

**Chairperson: Denis Chabot
Rapporteur: Sonia Dubé**

Maurice Lamontagne Institute
Fisheries and Oceans Canada
850 Route de la Mer, P.O. Box 1000
Mont-Joli, Quebec G5H 3Z4

Preface

The purpose of these proceedings is to document the key activities and discussions of the meeting. The proceedings may include research recommendations, uncertainties and the rationale for decisions made during the meeting. Proceedings may also document when data, analyses or interpretations were reviewed and rejected on scientific grounds, including the reason(s) for rejection. Therefore, interpretations and opinions presented in this report may be factually incorrect or misleading, but are included to record, as faithfully as possible, what was considered at the meeting. No statements are to be taken as reflecting the conclusions of the meeting unless they are clearly identified as such. Moreover, further review may result in changes to the conclusions, particularly if additional information was identified as relevant to the topics being considered, but not available at the time of the meeting. In the rare case when there are formal dissenting views, these are also archived as appendices to the proceedings.

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SUMMARY

This document contains the proceedings from the meeting held within the regional Assessment of Greenland halibut in the Gulf of St. Lawrence (4RST). This review process was held on February 22, 2017 at the Maurice Lamontagne Institute in Mont-Joli. This meeting gathered more than forty participants from sciences, management and industry. These proceedings contain the essential parts of the presentations and discussions held and relate the recommendations and conclusions that were presented during the review.

SOMMAIRE

Ce document renferme le compte rendu de l'examen régional par des pairs portant sur l'évaluation du stock de flétan du Groenland du golfe du Saint-Laurent (4RST). Cette revue, qui s'est déroulée le 22 février 2017 à l'Institut Maurice-Lamontagne à Mont-Joli, a réuni plus d'une quarantaine de participants des sciences, de la gestion et de l'industrie. Ce compte rendu contient l'essentiel des présentations et des discussions qui ont eu lieu pendant la réunion et fait état des recommandations et conclusions émises au moment de la revue.

INTRODUCTION

The Quebec Region of Fisheries and Oceans Canada (DFO) is responsible for assessing several stocks of fish and invertebrate species harvested in the Estuary and Gulf of St. Lawrence. Most of these stocks are periodically assessed as part of a regional advisory process conducted at the Maurice Lamontagne Institute in Mont-Joli. This document consists of the proceedings of the assessment meeting held on February 22, 2017, on the assessment of the Gulf of St. Lawrence Greenland Halibut stock (4RST).

The objective of the review was to determine whether there were any changes in the resource's status and whether adjustments were required to the management plans based on the chosen conservation approach, the ultimate goal being to provide scientific advice on managing the Gulf of St. Lawrence Greenland Halibut stock (4RST) for the 2017 and 2018 fishing seasons.

These proceedings report on the main points discussed in the presentations and deliberations stemming from the activities of the stock assessment regional committee. The regional review is a process open to all participants who are able to provide a critical outlook on the status of the assessed resources. Accordingly, participants from outside DFO are invited to take part in the committee's activities within the defined terms of reference for this review (Appendices 1 and 2). The proceedings also list the recommendations made by meeting participants.

CONTEXT

Meeting chairperson Denis Chabot welcomes the participants. He goes over the peer review objectives and agenda. After the participants introduce themselves, stock assessment biologist Hugo Bourdages begins the meeting by highlighting the contribution of his collaborators. He presents the agenda and the framework for the review. Mr. Bourdages provides an overview of the 4RST Greenland Halibut (Turbot) fishery, which includes 89 active licences in Quebec and 60 in Newfoundland. The fishery is dominated by fixed gear vessels.

Some points regarding turbot biology are described. The Gulf population is considered an isolated Northwest Atlantic stock. Ecosystem models highlight the trophic relationships (predator-prey) of the small and large turbot. Deep water temperature increased in the Gulf, and in particular, in northern Anticosti and Esquiman. For the past four or five years, fish have been found on average at temperatures over 6 °C, specifically more than 1 °C above the series average (1990-2015).

- It is stated that 99% of catches are from gillnets. There is currently no directed bottom longline fishery. For two or three years, the industry has been looking for a substitute to gillnet fishery.
- It is noted that the distribution of turbot is concentrated in the western Gulf. The area of occupancy remained constant (85,000 km²), although 95% of the biomass is concentrated in 50,000 km².
- Note that it is important to review the diets regularly, because the arrival of small redfish in recent years has changed the diet of turbot, and small redfish are an important prey for the large turbot. In 2010, the diet of turbot consisted of 9% of redfish, whereas this percentage is currently 61%.
- According to the trawl survey in the northern Gulf of St. Lawrence, there is currently an increase in the biomass of fish and a reduction in invertebrates, including species of shrimp.

Before proceeding with the resource assessment, brief presentations on ecosystem considerations are introduced. Claude Savenkoff presented the results of simulation models designed to assess the vulnerability of key commercial species—such as turbot—to climate change through their affinity to certain environmental parameters (depth, temperature, salinity, oxygen, prey). In the long term, if warming of the deep waters continues, the Greenland Halibut's range could decrease in the northern Gulf of St. Lawrence. Presentations made by Denis Chabot focused on modelling turbot's vulnerability to warming and the deterioration of dissolved oxygen conditions in deep water, as well as on respirometry (measurement of hypoxia tolerance). If the water warms up, the turbot will need more dissolved oxygen to carry out its activities.

- Note that turbot is already present in areas with low dissolved oxygen levels (e.g. Estuary), but no area is as hypoxic as the area that is forecast for the end of the century in the Estuary. We would have to "force" the model for this type of situation, because currently, the results are not very conclusive regarding the impact of hypoxia on the turbot.
- All the same, we can agree that we have to draw the line somewhere. While there is less oxygen in the water, this reduces the degree of flexibility in terms of energy use in hypoxic water, especially if the water becomes warmer.
- However, some participants feel that the turbot could benefit from certain hypoxic habitats. The Estuary could become a refuge to protect turbot from its predators. It is also a nursery and feeding area.
- However, it is still difficult to predict how the species will adapt to climate change. The industry has expressed some concern about this.

ASSESSMENT OF THE RESOURCE

FISHERY

Mr. Bourdages presents commercial fishery statistics and biological data from the commercial sampling program. Greenland Halibut landings reached 3,228 t (preliminary on December 31) in 2016–2017, out of an allocation of 3,751 t. The fishing season will last until May 14, 2017. For the past three years, over 83% of catches have been made in the western Gulf. Catches are lower in Esquiman and negligible north of Anticosti. The catch per unit effort (CPUE) is very high in the western Gulf but is lower in northern Anticosti and Esquiman.

- With existing tools (logbooks, satellite positioning), we seem to obtain a very precise distribution of effort.
- Turbot bycatch caught by shrimpers represents one fish out of 200 in the northern Gulf (0.4%); this estimate is considered relative. The Nordmore grate ensures that large turbot are not caught in shrimp trawlers, which is not the case for small turbot.
- A pilot project involving the use of a separator on board shrimpers in order to facilitate shrimp sorting work is underway. It seems that no difference was observed between the bycatch of boats using the separator and those that did not use it.

In directed gillnet fisheries, at-sea observers estimated bycatch at an average of 15% the weight of Greenland Halibut catches. About one-third of these bycatches was landed.

- Industry representatives have strong reservations about the observer data.

DFO AND THE MOBILE GEAR SENTINEL SURVEYS

Mr. Bourdages reviews the data from the DFO scientific survey and the scientific mobile sentinel survey. The biomass index from the DFO survey for fish over 40 cm decreased slightly in 2016, while that of pre-recruits from 30 to 40 cm increased slightly. In both cases, the indicators are comparable to the series average. The size at sexual maturity decreased over the past two years, reaching the lowest value observed since 1990, i.e. 33 cm for males and 41 cm for females. The 2012, 2013 and 2014 cohorts are very strong and will become recruits to the fishery in 2018, while the 2015 cohort is very weak. 2013 and 2014 cohort growth is slower than normal, which could delay their recruitment to the fishery.

- Questions are asked about the reasons for the reduced growth of 2013 and 2014 cohorts (e.g. competition for food, environmental conditions).
- Moreover, the downward trend in size at maturity concerned the participants. Several factors might be involved, but there is no absolute certainty for now. Suggestions were made to further examine this issue by sector and to review the reading on maturity.

SCALE MODEL

The biologist presented a statistical catch at length (SCALE) model as a tool for assessing the Greenland Halibut population in the Gulf of St. Lawrence. The total biomass of Greenland Halibut estimated by a preliminary population dynamic model (SCALE) has increased since 2013 and is at its highest level since 1990. The arrival of the 2012 and 2013 cohorts have contributed to this increase.

- It is noted that the model fits well enough to observed data, with the exception of length frequencies from DFO surveys in 2015 and 2016.
- Suggestions were made to enter new growth curves. An internal recodage would adjust curves based on cohorts.

EXPLOITATION RATE

The exploitation rate (landings versus biomass) is presented by fishing sector and for the 4RST. Locally, there was a decrease in catches, CPUE, and biomass in northern Anticosti and the head of the Esquiman Channel, as well as an increase in bottom temperature.

PRECAUTIONARY APPROACH

The longest possible time series is used to determine the points of reference, that is, the biomass index for fish longer than 40 cm from the 1990-2016 DFO survey series. Mr. Bourdages briefly describes the approach with the two reference points (Limit Reference Point (LRP) and Upper Reference Point (URP)) and three zones (Healthy, Cautious and Critical). The LRP must be determined by Science, while the URP is set by Fisheries Management.

- It is agreed that the precautionary approach will promote eco-certification and the opening of markets.
- For now, we prefer to base the precautionary approach on an empirical approach, which is also very current, given that the SCALE model still requires some tweaking.
- It is noted that the LRP corresponds to B_{rec} , i.e. to the lowest population observed in the past, followed by a recovery. Although other suggestions were raised (average of B_{rec} , $40\%B_{msy}$), we decided to retain B_{rec} and tweak everything through the decision rules.

- A suggestion was made to examine the indicators for the Lady Hammond (before 1990) to validate the choice of B_{rec} .
- For the URP, it is advisable to use $80\%B_{msy}$, which many of the participants deem adequate.

RESEARCH

Publications from the past two years:

- Bourdages, H., Brassard, C., Desgagnés, M., Galbraith, P., Gauthier, J., Légaré, B., Nozères, C. and Parent, E. 2017. Preliminary results from the groundfish and shrimp multidisciplinary survey in August 2016 in the Estuary and northern Gulf of St. Lawrence. DFO Can. Sci. Advis. Sec. Res. Doc. 2017/002. v + 88 p.
- Galbraith, P.S., Chassé, J., Caverhill, C., Nicot, P., Gilbert, D., Pettigrew, B., Lefavre, D., Brickman, D., Devine, L., and Lafleur, C. 2016. Physical Oceanographic Conditions in the Gulf of St. Lawrence in 2015. Secr. Sci. Advis. Sec. Res. Doc. 2016/056. v + 90 p.
- Mejri, S., Tremblay, R., Lambert, Y. and Audet, C. 2017. Assessing fatty acid remodelling during embryogenesis in Greenland halibut (*Reinhardtius hippoglossoides*) exposed to hypoxia. Mar. Biol. 164:5
- Pillet, M., Dupont-Prinet, A., Chabot, D., Tremblay, R. and Audet, C. 2016. Effects of exposure to hypoxia on metabolic pathways in northern shrimp (*Pandalus borealis*) and Greenland halibut (*Reinhardtius hippoglossoides*). J. Exp. Mar. Biol. Ecol. 483, pp. 88-96
- Stortini, C.H., Chabot, D. and Shackell, N.L. 2017. Marine species in ambient low-oxygen regions subject to double jeopardy impacts of climate change. Global Change Biology. 23: 2284-2296.
- Youcef, W. A., Lambert, Y. and Audet, C. 2015. Variations in length and growth of Greenland Halibut juveniles in relation to environmental conditions. Fish. Res., 167 pp. 38-47

Research projects underway at the MLI:

- Integrated management tools for sustainable exploitation of Greenland Halibut throughout Eastern Canada, NSERC-Strategic, 2015-2018, Louis Bernatchez (Université Laval), Céline Audet, Réjean Tremblay (ISMER), Pascal Sirois (UQAC) and Yvan Lambert (DFO).
- Integration of climate change and ecosystem parameters in shrimp and Greenland Halibut stock assessment processes, Aquatic Climate Change Adaptation Services Program, ACCASP (adaptation tools), 2013-2016, Claude Savenkoff, Marie-Noëlle Bourassa, Hugo Bourdages, Peter Galbraith, Nicolas Lambert (DFO, MLI); Joël Chassé (DFO, GFC); Sandrine Vaz (IFREMER, France).
- Trophic interactions (predators and prey) and the main causes of mortality associated with Greenland Halibut in the Estuary and northern Gulf of St. Lawrence (2011-2014), 2015-2017, Claude Savenkoff, Hugo Bourdages, Denis Chabot (DFO, MLI).

Participants added:

- Work on hypoxia at different levels of temperature;
- Work on acidification and its impact (relation to hypoxia).

Future research projects at the MLI:

Proposed projects:

- Use of VMS (vessel monitoring system) data;
- Continuation of the development of population dynamics models;
- Development of a precautionary approach;
- Impact of the fishery on the ecosystem and habitat.

We added:

- Electronic marking (Estuary);
- Determination of maturity ogives.

INTERIM YEAR

The assessment is scheduled every two years. Monitoring indicators for the interim year are identified (landings and abundance indicators from the DFO survey) and a Science Response report is scheduled for the fall. A stock assessment might be initiated during an interim year if there is a decrease of more than 30% in the biomass index of fish over 40 cm (DFO survey), if this biomass is in the Cautious and Critical areas.

- It is stated that this assessment trigger is valid for the next year, because the stock is stable or increasing, which would be different if it were decreasing. This element could be adjusted during the next assessment depending on the status of the stock.

CONCLUSION

HIGHLIGHTS AND RECOMMENDATIONS

The highlights are presented and the participants comment on them. Some facts are withdrawn; others are simplified. Comments having to do with stylistic rewording are not reported.

- The industry considers that the amount of bycatch landed represents more than a third of the bycatch. They do not believe that two-thirds of bycatches are discarded at sea. They question the observer data.
- Industry representatives believe that these discards are ineligible. They should be landed and recorded.
- It should be pointed out that the SCALE model is under development. There is uncertainty about this model.
- Industry members are not as concerned about the status of turbot north of Anticosti.
- A consensus regarding the recommendation is obtained without discussion.

The **recommendation** is formulated as follows:

Exploitable biomass of the 4RST Greenland Halibut stock has been high and stable since 2008. The landings of the past 10 years have helped maintain a stable exploitation rate. The SCALE model projection indicates that exploitable biomass will remain stable with annual landings of 3,750 t for the next two fishery seasons.

APPENDIX 1 – LIST OF PARTICIPANTS

NameAffiliation

Bassi, Laélien	ISMER
Beauchamp, Jocelin	Industry
Bernier, Denis	DFO Science
Boucher, André	RPPNG
Boucher Jean-René	RPPNG
Bourdages, Hugo	DFO Science
Brassard, Claude	DFO Science
Brulotte, Sylvie	DFO Science
Carruthers, Erin	FFAW
Castonguay, Martin	DFO Science
Côté, Jean-François	Industry
Cotton, Allen	Industry
Chabot, Denis	DFO Science
Coffin, David	DFO Fisheries Management
Cyr, Charley	DFO Science
Denis, Marcel	ACPG
Desgagnés, Mathieu	DFO Science
Dubé, Frank	Fisherman
Dubé, Sonia	DFO Science
Dufresne, Yvon	DFO Science
Dupuis, Mario	Industry
Dwyer, Shelley	Government of Newfoundland and Labrador
Gauthier, Johanne	DFO Science
Ghinter, Léopold	ISMER
Gilbert, Michel	DFO Science
Goudreau, Patrice	DFO Science
Hurtubise, Sylvain	DFO Science
LaCosta, Roger	Industry
Lambert, Yvan	DFO Science
Langelier, Serge	AMIK
LeBris, Arnaud	Memorial University of Newfoundland
Lussier, Jean-François	DFO Science
Morneau, Renée	DFO Science
Nadeau, Paul	LNSFA
Nozères, Claude	DFO Science
Pinette, Majoric	Pessamit First Nation
Robert, Dominique	UQAR
Sandt-Duguay, Emmanuel	MMAFMA
Savenkoff, Claude	DFO Science
Spingle, Jason	FFAW
St-Pierre, Sylvie	DFO Science
Trottier, Steve	DFO Fisheries Management
Vallée, Daniel	RPPNG

APPENDIX 2 – TERMS OF REFERENCE

Assessment of the Gulf of St. Lawrence Greenland Halibut stock (4RST)

Regional Peer Review – Quebec Region

February 22, 2017

Mont-Joli, QC

Chairperson: Denis Chabot

Background

The Gulf of St. Lawrence (4RST) Greenland Halibut (also called turbot) fishery is now dominated by boats equipped with gillnets, whose home ports are located in Quebec or on the west coast of Newfoundland. To protect the population's reproductive potential, this fishery is subject to several management measures including the control of catches by a total allowable catch (TAC).

At the request of the Fisheries Management Branch, resource assessment is done every two years. The purpose of the review is to determine whether changes have occurred in the status of the resource that would justify adjustments to the management plan based on the retained conservation approach.

Objectives

Provide Science Advisory Report on Greenland Halibut stock status in NAFO and 4RST areas. This report shall include:

- Description of the biology of Greenland Halibut and its distribution;
- A summary of oceanographic conditions in the Gulf;
- Analysis of the commercial fishing data including landings, fishing effort, catch per unit effort, biological data and Greenland Halibut by-catches in other fisheries;
- Analysis of data from the DFO annual research trawl survey in August and mobile sentinel fisheries;
- Analysis of fishing effort distribution according to Greenland Halibut abundance distribution;
- Analysis of the Statistical Catch at Length (SCALE) model as a potential tool for assessing the Greenland Halibut population;
- Identification of reference points consistent with the precautionary approach;
- Analysis of Greenland halibut directed bycatches;
- Perspectives for 2017 and 2018 based on available indicators;
- Determination of the process for providing an advisory report during interim years, including a description of the conditions that could justify a complete stock assessment earlier than initially planned;
- Identification and prioritization of research projects to be considered for the future.

Expected publications

- Science Advisory Report on the Greenland Halibut in the Gulf of St. Lawrence (4RST)
- Research document
- Proceedings containing a summary of discussions

Participation

- Fisheries and Oceans Canada (DFO) (Science and Fisheries Management sectors)
- Fishing industry
- Provincial representatives
- Aboriginal communities / organizations
- External experts